

Big Bluestem: Protecting Soil, Water & Habitats

**How can the incorporation of
big bluestem grass into seed mixes
help to stabilize soil and improve
habitat and water quality?**

HMS Backyard Backlash

2017-2018 Lexus Eco Challenge Team

Houghton Middle School

Houghton, MI

Natural Resource Committee

April 12, 2018



Lexus Scholastic Eco Challenge



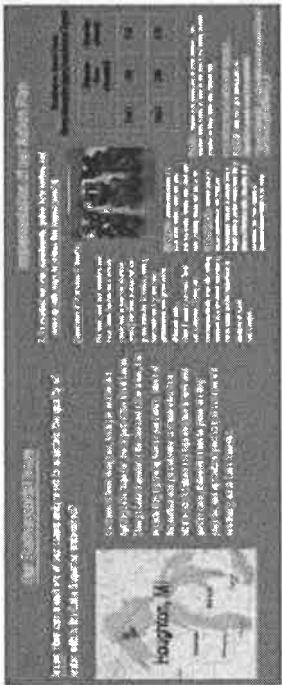
Purpose: To identify an environmental problem in our community, dig up information, come up with an action plan (address the issue), and report to the community.

1. Nationwide contest open to middle & high school student teams
2. Two different categories: Air & Climate, Land & Water
3. Round 1: Judging & Prizes
4. Round 2: Top 8 teams in each category invited

Link to Lexus Eco Challenge: <http://lexus.scholastic.com/>

Link to our team website: hms2017ecochallenge.weebly.com

Congratulations to the Winners of the 2017–2018 Land & Water Challenge!



HMS Backyard Backlash, Michigan

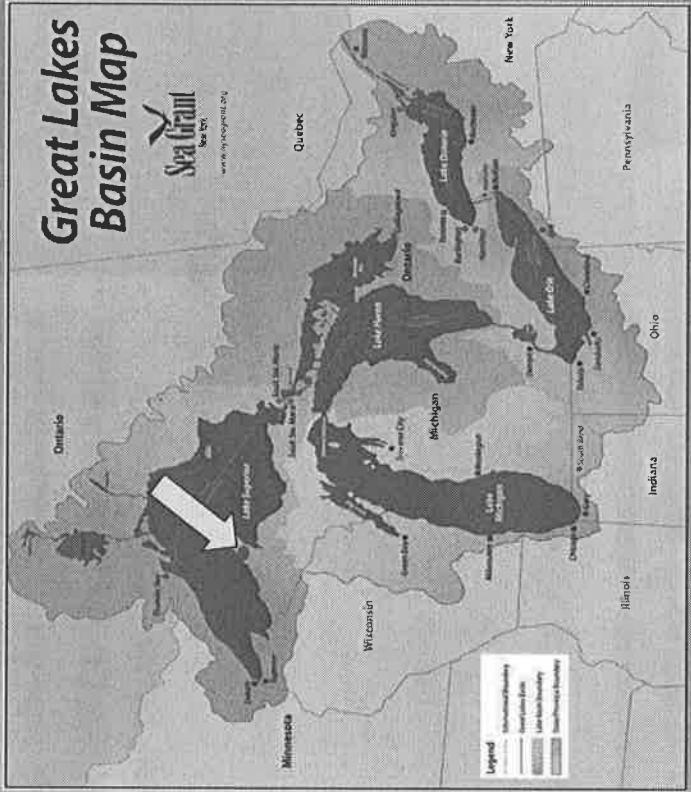
Team: Seojun, Sully, Davin, Logan, Seth, Mercedes, Linda, Sonia, Micaela, Leah
Lake Superior—the largest, coldest, and deepest of the Great Lakes—is under a threat of contamination in places like Michigan due to the area's large and growing population. HMS Backyard Backlash and teacher advisor Sarah Geborkoff conducted research and met with local scientists to learn about the dangers that synthetic soil and over-fertilization present to freshwater. They carried out soil experiments and planted bluestem grass around their school garden to prevent nitrates from damaging the area beyond its borders. The students shared their findings with their school and local media.

Land & Water Challenge

Our Environmental Issue: How can we work to maintain the quality of surface and groundwater within the Lake Superior and Lake Michigan watersheds?

Background information:

1. Upper Michigan is part of two major watersheds
2. Contaminants in soil and water carried by groundwater and surface runoff



Background Information

1. Ecologic Impact: Excessive Nitrates in Soil and Water

- A. Sources of excessive nitrates
- B. Carbon-to-nitrogen ratio
- C. Effects of excessive nitrates on plant growth
- D. Effects of excessive nitrates on our watershed (and Great Lakes)

Image: Lake Erie, summer months



Background Information

- Benefits of planting perennial vs. annual grass species

Annuals

Pros	Cons
More affordable	Not as hardy
May germinate quicker	Thinner leaves
Has more variety and color	Dies back annually Shorter growing season

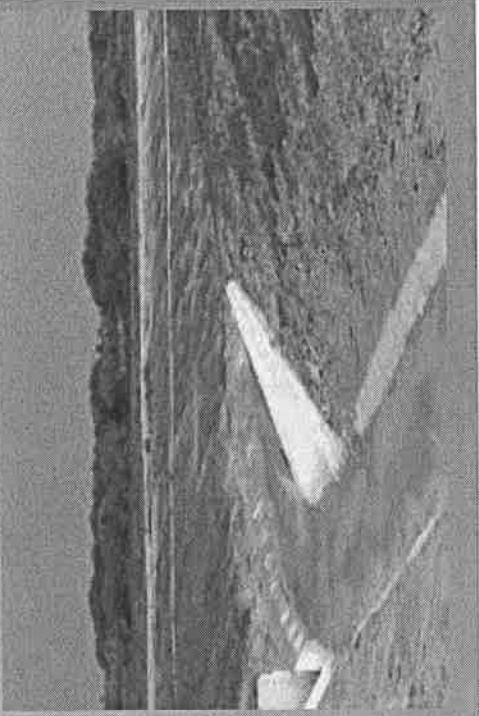
Perennials

Pros	Cons
Hardier & Longer Growing season	More expensive
May require less work, good ground cover	May take longer to germinate/grow
Removes more 'nutrients' (nitrates, metals) from soil	May overpopulate



Relevance of Our Project

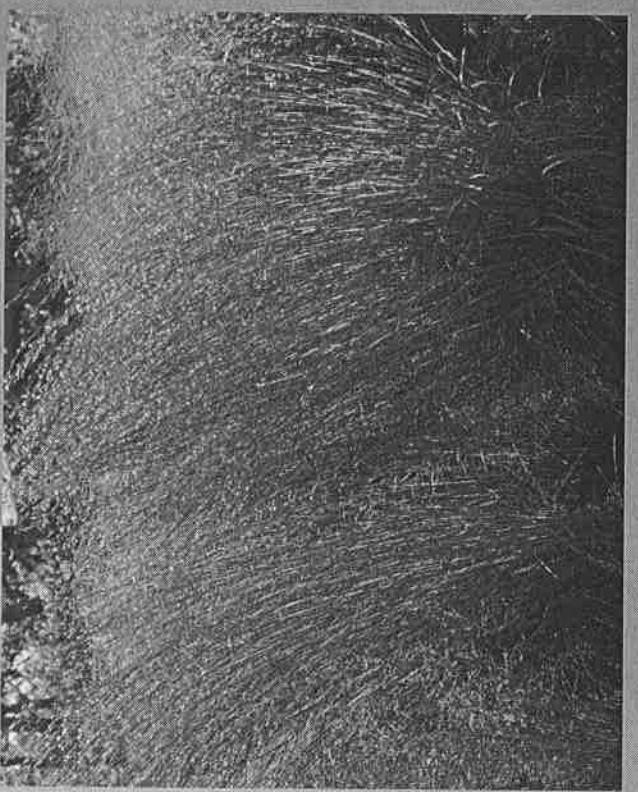
- Michigan Department of Transportation (MDOT) - Impact of roadside projects
 - Grass seed mixes used by MDOT:
 - Contain mix of annual & perennial species
 - No native perennial species used
 - Runoff & Erosion along roadsides
 - Land use in Upper Michigan
- Problem: Seeding projects along roadways aren't always effective in stabilizing soil and slowing runoff



Our Solution:

Hypothesis: The use of native, perennial grasses in landscaping projects can improve water quality as well as have other positive ecological impacts

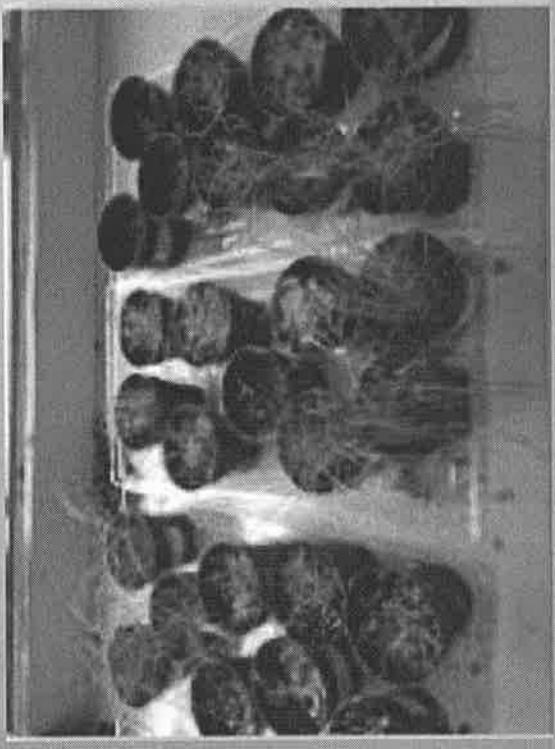
1. *Andropogon gerardii* (Big Bluestem)
 - Native species
 - Perennial grass
 - Characteristics
 - Ecologic benefits



Experiment #1 - Removing Nitrates from Soil

Test: Will big bluestem absorb excess soil nitrates from fertilizers?

1. Grass trials: bluestem, Scott's seed (store bought lawn mix).
2. Soil types used: organic, synthetic, and natural topsoil



Left Group: 3 trials of each grass (organic soil)

Middle Group: 3 trials of each grass (synthetic soil)

Right Group: 3 trials of each grass (topsoil soil)

Testing for Soil Nitrates

Our project is sponsored by Nitrate Elimination Company Inc. (NECI)

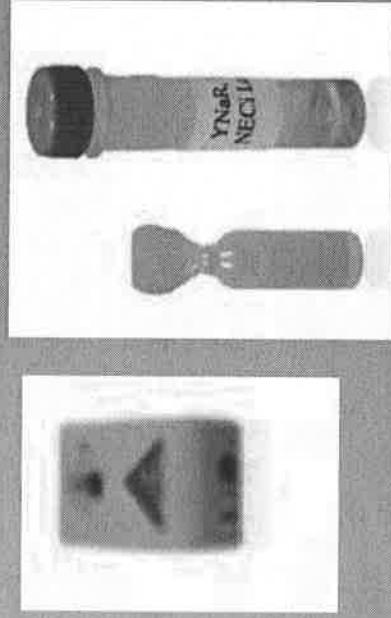
1. Use of Enzymes - biological catalysts
2. Benefits to testing with enzymes



Clean Water. Fertile Soil. Serious Science.

2. Sample collection & Testing

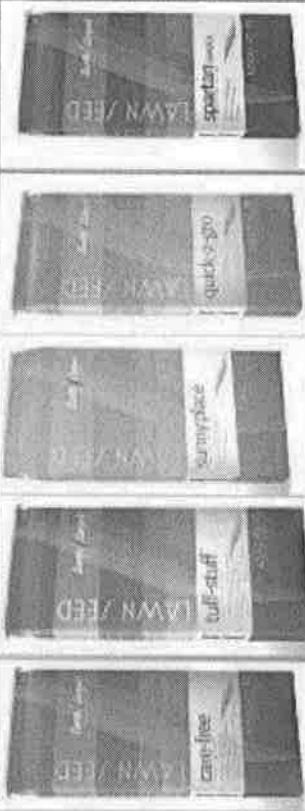
- A. Initial Soil Samples (collected June 2017)
 - Bagged & frozen
 - Thawed in August
- B. Final Soil Samples (collected August 2017)
- C. Testing process (Use of enzymes, photometer)
- D. Constant variables



Results			
Sample	Initial ppm Nitrate	Final ppm Nitrate	Change in (Soil) Nitrate ppm
OB1	3.13	1.21	-1.92
OB2	4.69	2.96	-1.73
OG1	35.83	1.06	-34.77
OG2	24.59	3.53	-21.06
NB1	1.98	0.47	-1.51
NB2	4.78	2.70	-2.08
NG1	7.69	2.26	-5.43
NG2	9.05	2.35	-6.70
SB1	3.97	2.68	-1.29
SB2	2.41	1.20	-1.21
SG1	26.59	18.75	-7.84
SG2	12.89	9.82	-3.07
Key (Soil Sample)			
Soil Type		Seed Type	
O = Organic	N= Natural	S= Synthetic	G= Grass (Non-native/Annual) B= Bluestem

Experiment #2 - Comparison of MDOT Seed Mixes to Big Bluestem in Different Environments

Test: How will the growth and productivity of big bluestem grass compare with various seed mixes used by MDOT?



1. **Grass trials:** Big Bluestem, 'Carefree', 'Tuff-Stuff', 'Quick-2-Gro', 'Spartan', 'Sunny Place'
2. **Environmental trials:** 'Normal' - Initial water added (day 1)
'Wet' - Over-watered, daily
'Salt' - 10% salinity, daily
3. **Test duration:** Seven days (from date of seed germination)

Results: (MDOT Grass Mixes vs Big Bluestem)

1. Germination Rates
2. Different Growing Conditions:
 - A. 'Normal' (Control) Environment:
All mixes thrived except for MDOT mix 'Carefree'
 - B. Wet Environment:
-All 5 mixes grew well, but growth appeared somewhat stunted
'Carefree' (again) showed the poorest results

- C. Salty Environment: All mixes wilted. Bluestem showed the least signs of decay, had thicker blades and survived the longest
- Overall, Big Bluestem and MDOT mix Quick-2-Gro performed best, with Tuff Stuff as the second best growing MDOT mix



Grass trials

Possible Explanation & Sources of Error

1. Limited Time-frame for Experiment
 - MDOT mixes vs. Big Bluestem
 - Big Bluestem performance (summary)
2. Possible explanation of results
3. What to change when re-testing



Experiment #3 - Final Challenge

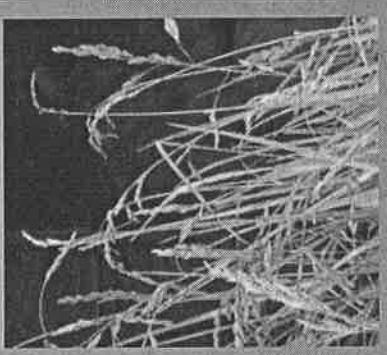
- Question from MDOT: How does (nonnative perennial species) Fescue, which is currently incorporated into seed mixes, compare to Big Bluestem?

We decided to find out

- Testing with new trials: Fescue (mix), Kentucky Bluegrass (also used in MDOT mixes), and Big Bluestem
- Retested: Big Bluestem, Tuff Stuff*, Quick-2-Gro*

*Highest performing of MDOT seed mixes from initial experimentation

Our team, presenting our initial experimentation results to members of MDOT (Sept. 2017)



Big Bluestem

Experiment #3: Setup and Variables

Experiment Design:

1. Five trials for each type of seeds
2. 30 cubic centimeters of sand
3. 120 cubic centimeters of soil
4. Thin layer of seeds - different types for different trials
5. Thin layer of soil to cover the seeds
6. 50 ml of water



Seed germination Initiated on 1/26/18

Dependent Variable -

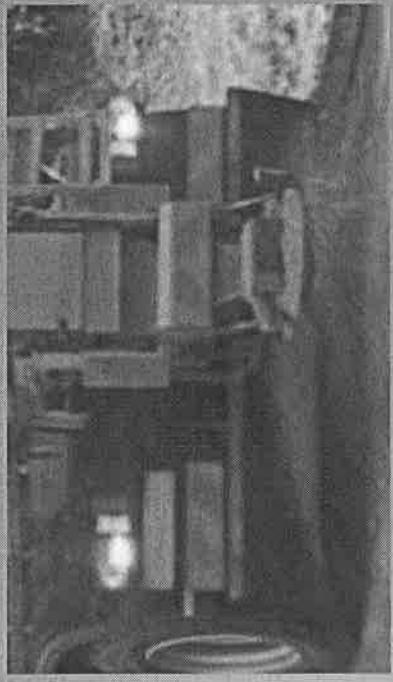
- Average Grass Blade Height (over time)
- Average Grass Blade Thickness (over time)
- Germination Rate & Time of Germination

Experiment #3: Setup & Variables

Independent Variable -

- Grass Type (Fescue, Kentucky Bluegrass, Big Bluestem, Tuff Stuff, Quick-2-Gro)
- Environment* (Dry, Wet, 'Normal', Salty)

*Initiated 3/1/18, approx. 4 weeks after planting the grass seed



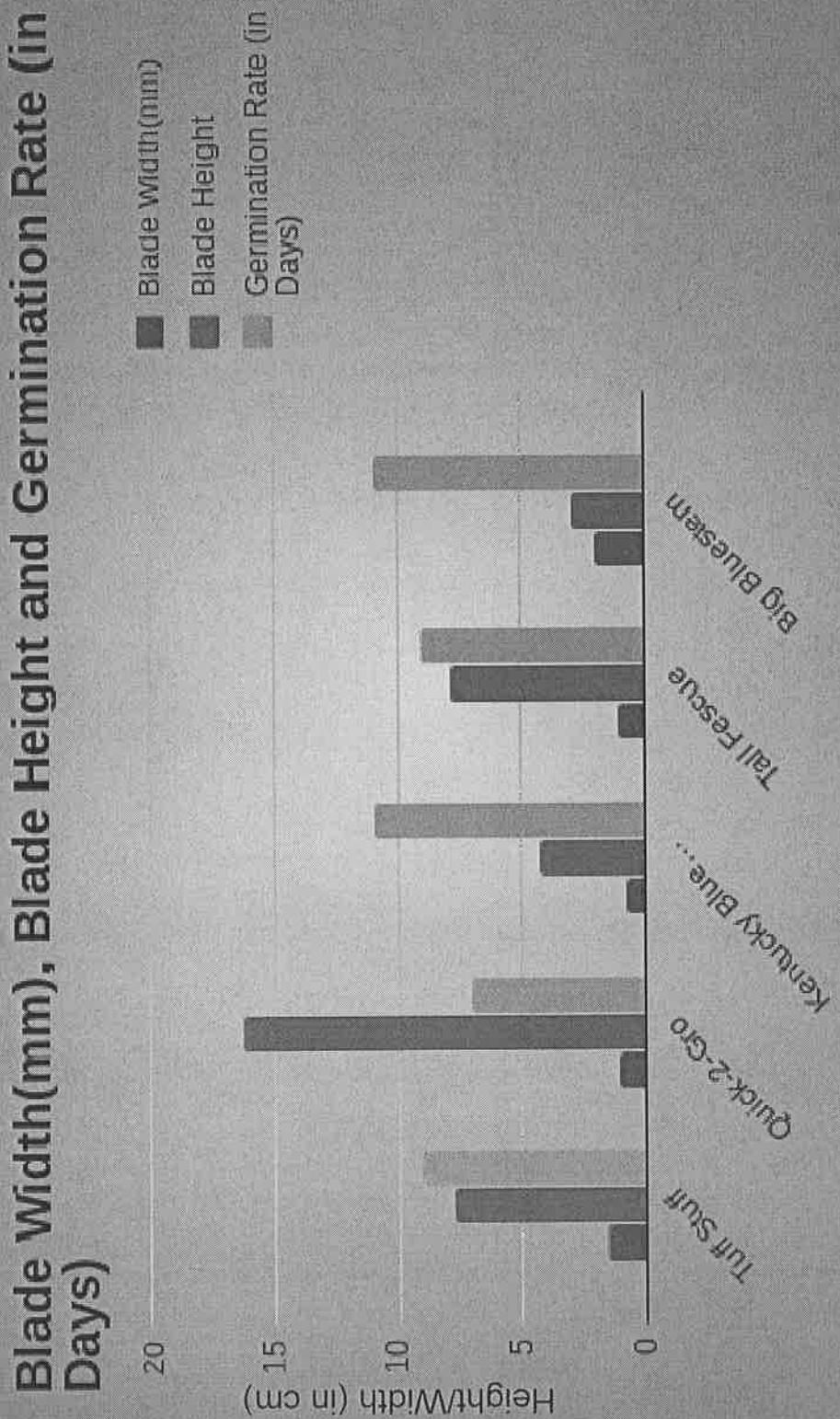
'Salty' trial is to mimic the effects of road salt added to soil

Constant Variables

- Soil type & volume
- Volume of water added during initial growth experiments (30 ml each watering)
- Frequency of water added (Monday, Wednesday, Friday)
- Exposure to sunlight
- Temperature of environment

Results: Grass Seed Germination & Growth

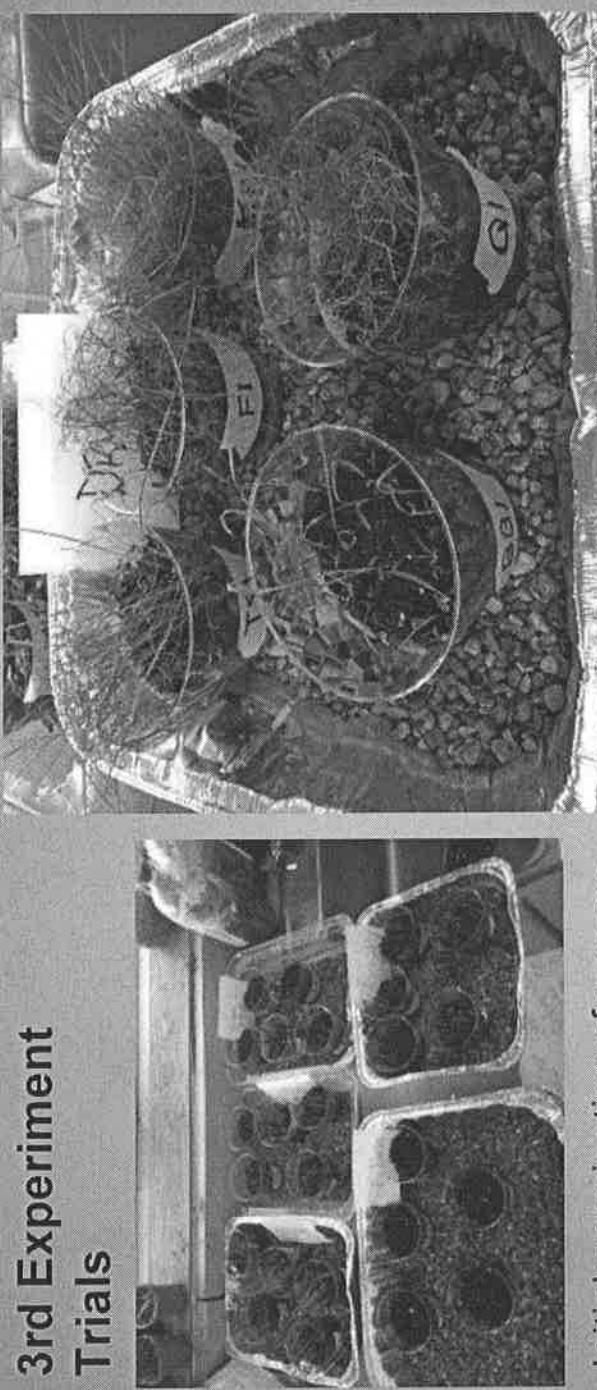
	Tuff Stuff (MDOT Mix)	Quick-2-Gro (MDOT Mix)	Kentucky Bluegrass (nonnative perennial)	Fescue Mix (nonnative perennial)	Big Bluestem (native perennial)
Blade width (mm)	1.5	1	0.75	1	<u>2</u>
Blade height (cm, 32 days from planting)	7.7	<u>16.3</u>	4.2	7.85	2.95
Germination Rate	9 days	<u>7 days</u>	11 days	9 days	11 days



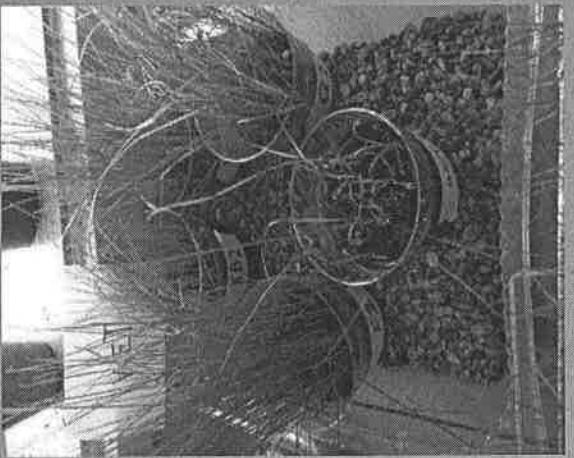
Grass Seed Performance in Different Environments

	Tuff Stuff (MDOT Mix)	Quick-2-Gro (MDOT Mix)	Kentucky Bluegrass (nonnative perennial)	Fescue (nonnative perennial)	Big Bluestem (native perennial)
Dry Soil	Phase 1: <u>20 ml H₂O every 3 days</u> <u>Observed After 1 week:</u>	Dry & yellow at tips	Green, but dry/paperish feel to leaves	Green, but dry/paperish feel to leaves. Some yellow at tips.	No signs of stress
	Phase 2: <u>No water</u>	Wilted First (4 days)	Signs of stress (yellowing/drying) Drooping at 4 days	Signs of stress (yellowing/drying) Drooping at 4 days	No signs of stress after 7 days
Wet Soil	Stable	Stable	Stable	Stable	Stable
Salty Soil	Last to wilt (Tie) 4 days	Wilt - 2 days	Wilt - 2 days	Wilt - 3 days	Last to wilt (Tie) 4 days

3rd Experiment Trials



Initial germination of grasses
Taken 02/05/18



(Above) Wet environment trials

(Above) The dry environment trial



The final pictures of our third experiment,
including wet, dry, and control trials

Conclusion

What Our Results Show

- Addition of Big Bluestem has benefits
- Reduction in runoff/soil exposure (blade width), hardness (dry and salty environment)
- Annuals should still be used in seed mixes but we should consider putting in more perennial and native grasses

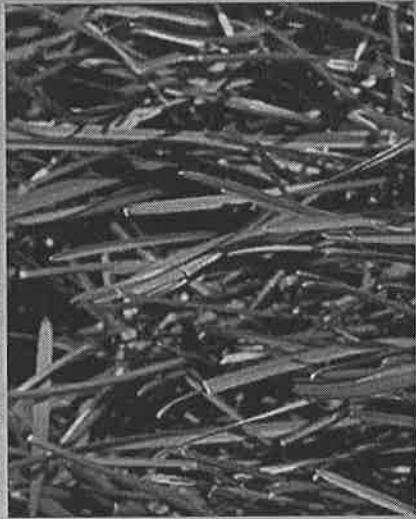


Sources of Error

- Sowing Seeds - Consistency
- Salty Environment (solution added to soil)
 - Concentration was too high
- Measurement of blade width & height - Accuracy
- If we were to repeat the experiment...

Additional Reasons to Incorporate Big Bluestem into Grass Mixes

- Kentucky Bluegrass (or Fescue) does not thrive in warm seasons like Big Bluestem
 - This could affect how many nitrates it absorbs in the soil
- Differences in root systems between Big Bluestem and Kentucky Bluegrass
 - Big Bluestem: extensive root system
 - Kentucky Bluegrass: shallow root system
- Negative effects of some Fescue varieties (i.e., Tall Fescue)
- Many organisms are dependent on Big Bluestem for shelter and food
- Capabilities of rhizodegradation, which is a method of phytoremediation



Outreach Efforts

- 6th Grade Presentations at HMS
 - Showed students our website and engaged them in a scavenger hunt to find information about our website.
- Exchange of Information - students in Xalapa, Vera Cruz, Mexico
 - To compare water and soil quality issues
 - To share our project and learn about their student work and projects in the areas of sustainability and environmental science
- Follow-up presentation to MDOT - 4/19 (Date of first visit - September 15th)



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1. Dr. Evan Kane (MTU Forestry Dept.)
2. Dr. Sigrid Resh (MTU Forestry Dept.)
3. Ellen R. Campbell
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us with materials to be used during testing.
4. Dr. Alex Mayer (MTU Civil & Env. Eng. Dept.)



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